

REVIEW OF FAA LCCA METHODOLOGY

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Review Team: Pavements



Dr. Dan Zollinger

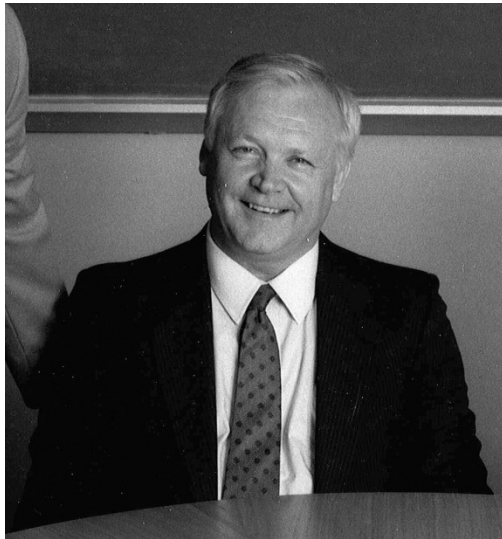
- Professor, TAMU
- Rigid Pavement Design and Performance
- 33 years experience



Dr. Dallas Little

- E. B. Snead Endowed Chair
- and Regent Fellow, TAMU
- Flexible Pavement Design
- 43 years experience

Review Team: Economics



Dr. William F. McFarland

- **Consultant**
- Mathematical Economics and Quantitative Analysis
- 24 yrs head of Economics Research Program at TTI



Dr. Dock Burke

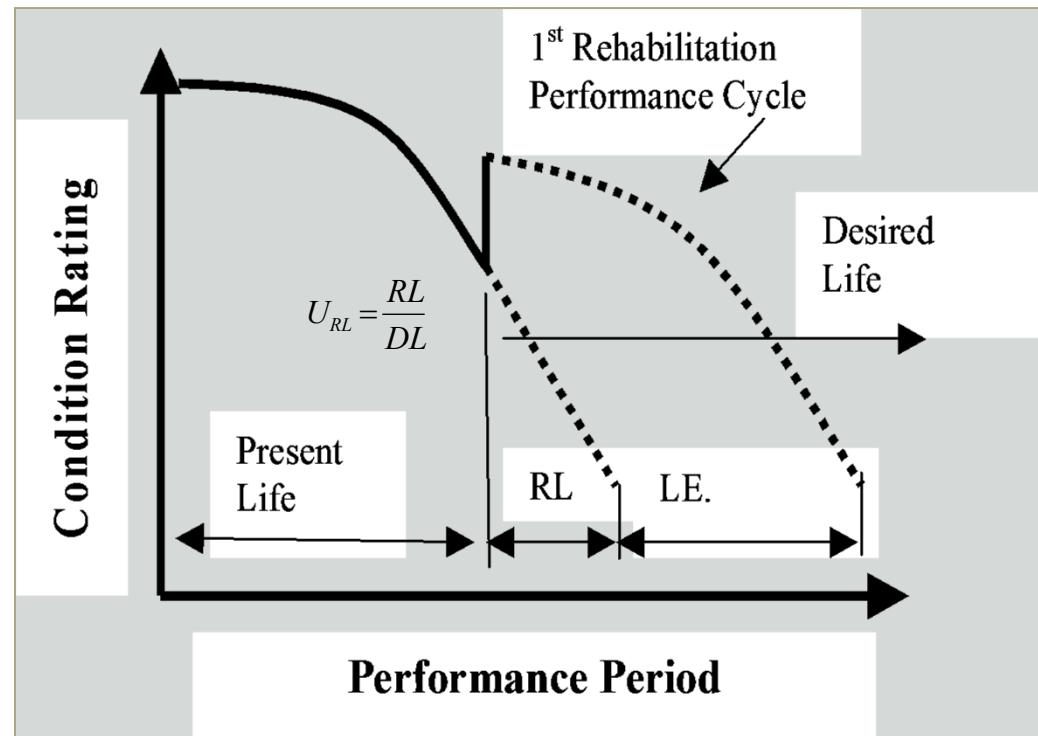
- Senior Research Scientist and Regents Fellow (Ret.)
- Economic and Financial Policy
- 45 years experience

Scope of Work

- **Review:**
 - Key elements of LCCA
 - PAVEAIR/AirCost report and program
 - Compare to other LCCA programs
- **Discuss and Elaborate:**
 - Key issues,
 - Differences, and
 - Problems/deficiencies as it would pertain to Airfield LCCA
- **Prepare Report of Findings:**
 - Respond to review comments
- **Write proposals:**
 - For further development and the
 - organization of a user's group to provide input

What is Life Cycle Cost Analysis (LCCA)?

- Type of cost-effectiveness
- Method of calculating Net Present Value
- Method of putting costs occurring at different times on a common, comparable basis



Airfield Pavement LCCA Literature of Interest

- 1981 - LCCA step-by-step procedure outlined in FAA Report DOT/FAA/RD-81/78 subtitled “**Engineering Manual**” (Epps & Wootan)
- 1995 - FAA LCCA Guidance in Appendix, “**Economic Analysis**,” FAA **AC 150/5320-6D** (Based on 1981 FAA “Engineering Manual”)
- 2009 - FAA **AC 150/5320-6E** (Based on 1981 FAA “Engineering Manual”) LCCA spreadsheets based on **FAA Guidance in Appendix 1**
- 2011 - **AirCost Program & Report** developed on AAPTP Project 06-06 by ARA

1981 FAA “Engineering Manual”

- Step-by-step procedures for:
 - Selecting alternatives,
 - Using Net Present Value and
 - Equivalent Uniform Annual Cost formulas
- Calculation tables similar to modern spreadsheets
- Uses real discount rate
- Uses constant unit costs based on average bid items
- Salvage value calculated as a function of remaining service life
- Uses 20 year analysis period in example problems

Appendix 1, Economic Analysis,” in AC 5320/150-6D (1995) and -6E (2009)

- Sound guidance for LCCA; basic procedures similar as in 1981
- Step-by-step procedure
- Short but fairly detailed LCCA approach
- Spreadsheet-like calculation tables
- Real discount rate: 4 percent
- Design life and analysis period of 20 years

2004 – FHWA'S RealCost LCCA COMPUTER PROGRAM

- FHWA DP 115
 - Deterministic and probabilistic analysis
 - Excess user costs
 - Has Graphical User Interface (GUI)
- User defines M&R alternatives and service lives
 - Based on historical data
- Several states use RealCost
 - A few states use probabilistic analysis but most do not
- AirCost carries many similarities

KEY ELEMENTS OF LCCA

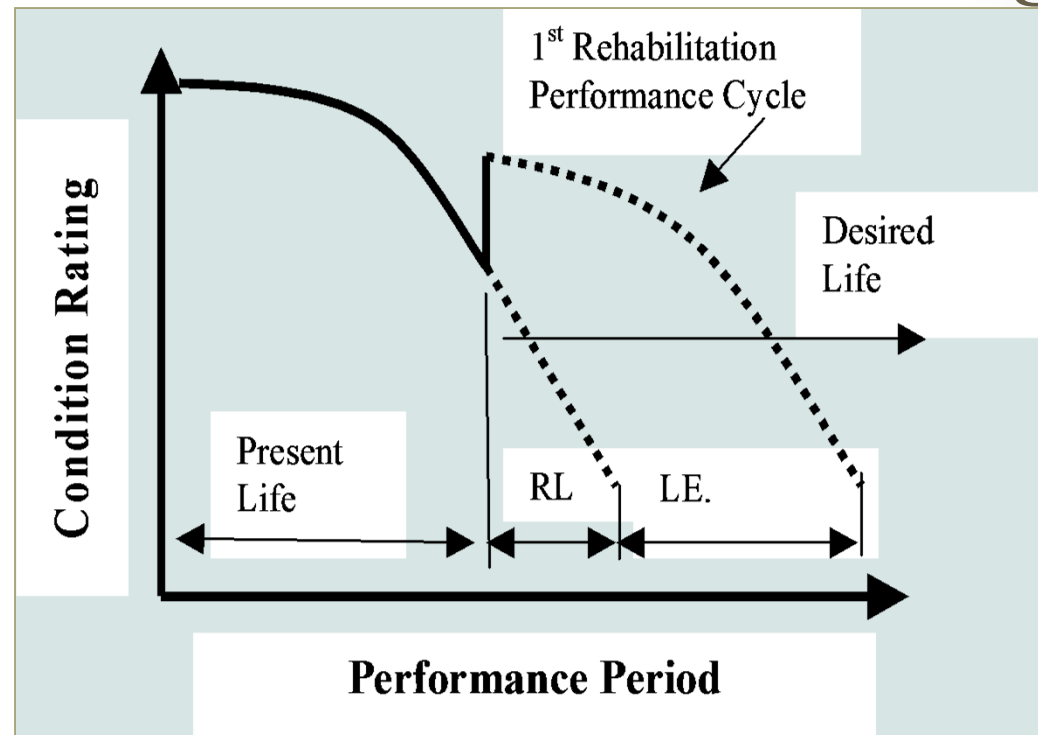
- Net Present Value (NPV) formula
- **Analysis Period**
- Discount Rate
- Initial and Future Pavement Costs
- M&R Schedule and Service Lives
- Salvage Value
- Excess User Costs

STEPS IN LCCA PROCEDURE,

APPENDIX 1

1. Identify and record key project data.
2. Determine condition of existing pavement.
3. Identify feasible alternatives.
4. Determine 1st Costs
5. Calculate LCC for each alternative.
6. Summarize length of construction time, and chances for success.
7. Evaluate the most promising alternatives based on:
 - life-cycle costs,
 - length of construction time,
 - Operational constraints, etc.

Step 2: Determine condition of existing pavement.



FAARFIELD
Thickness
Design

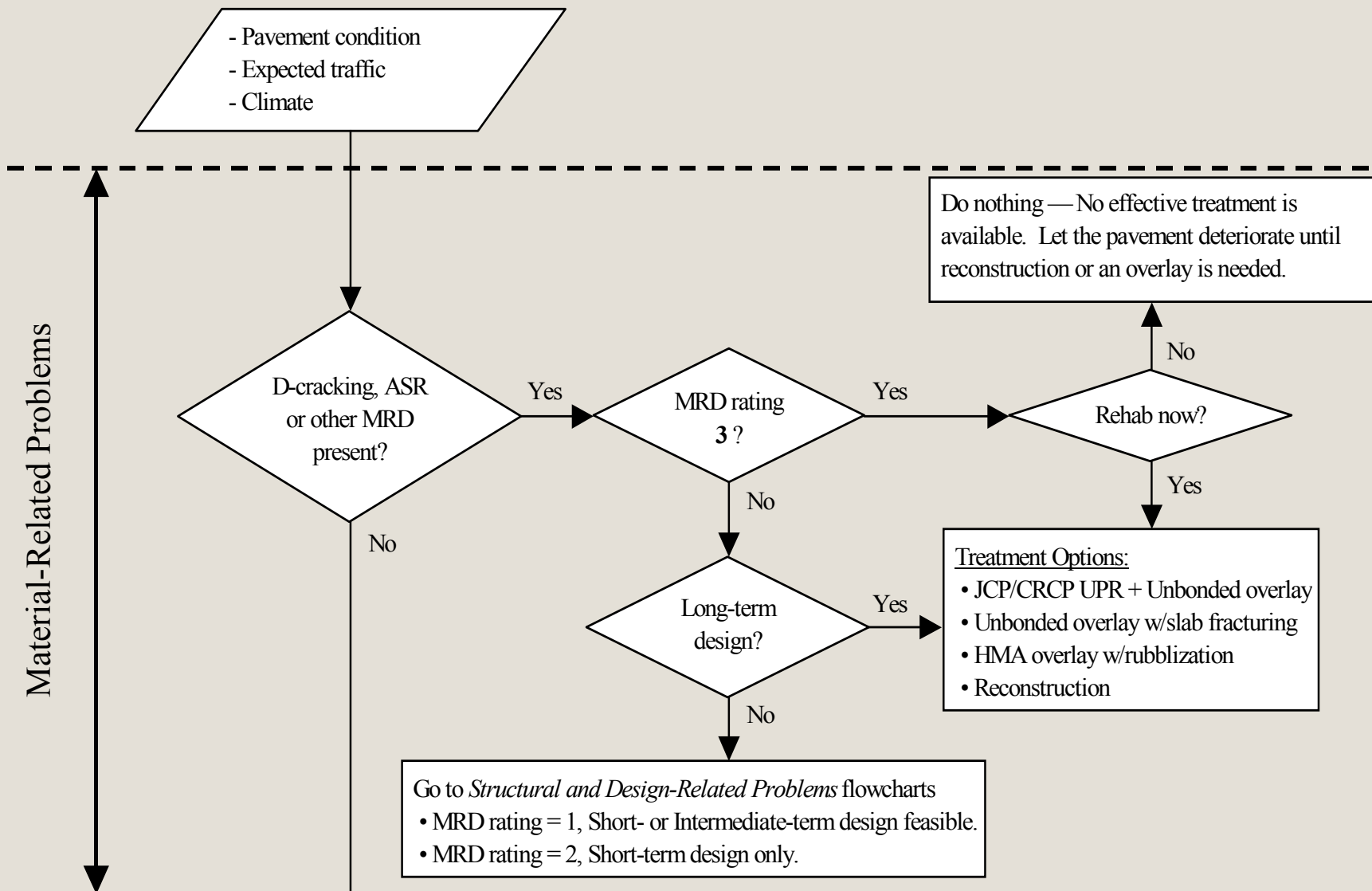
BAKFAA
Strength
Evaluation



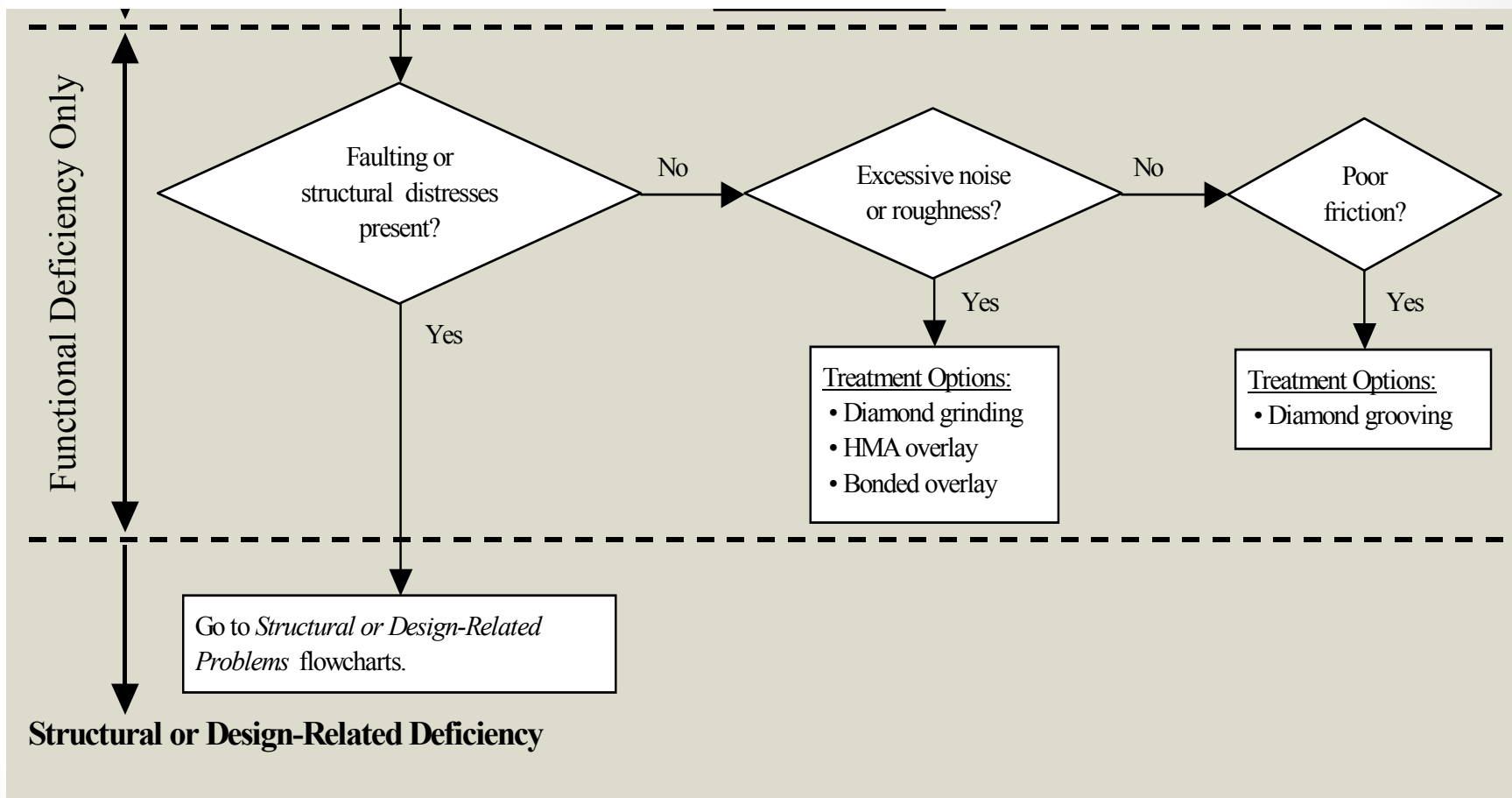
Step 3: Identify feasible alternatives.

- Design life (length of the analysis period).
- Existing pavement condition (structure and functional).
- Air-side operations.
- Climate and drainage condition.
- Constructability (construction time and cost including life-cycle and user costs).
- Expected performance life (life extension).

Feasible Treatment Selection Process

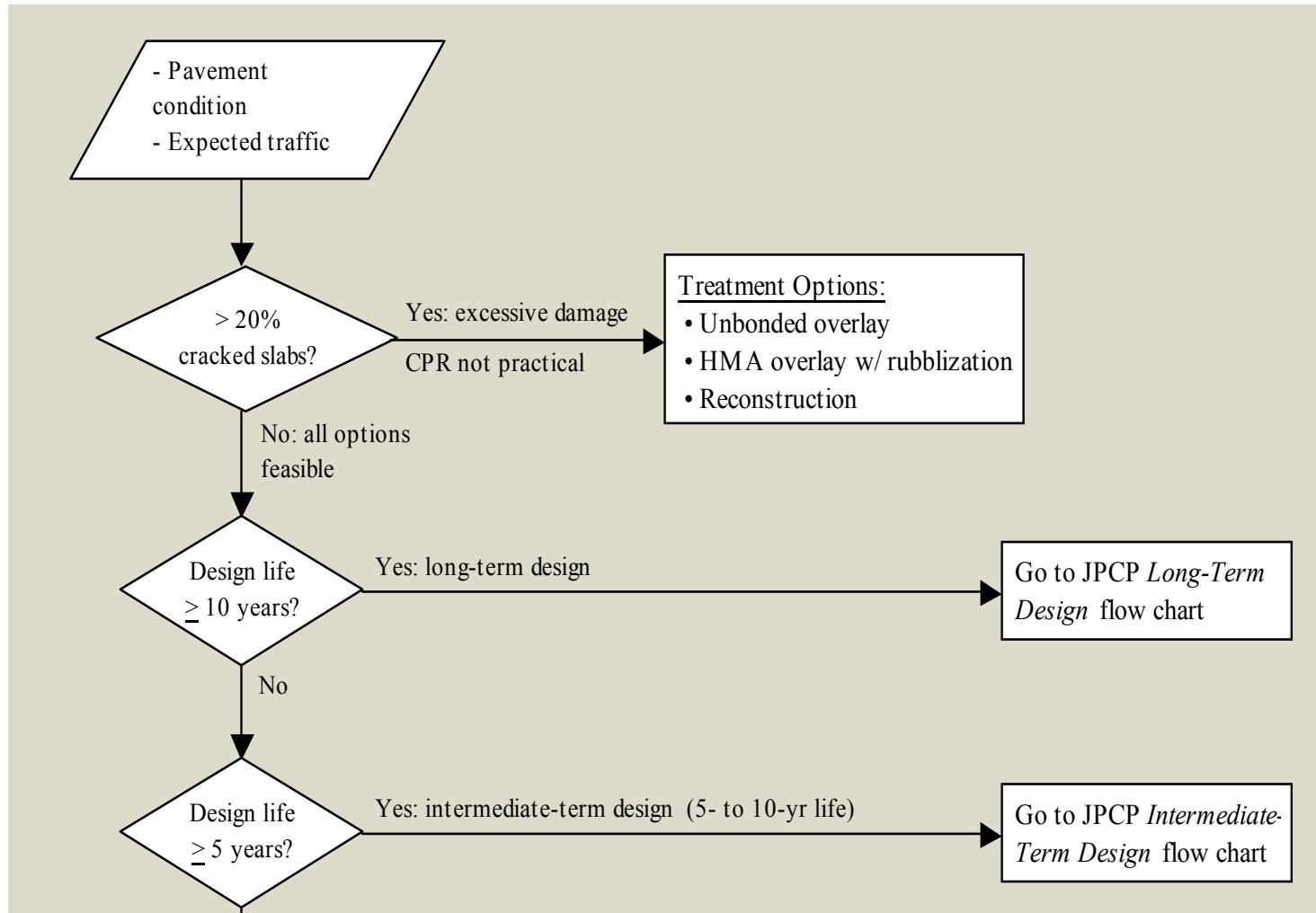


Functional Considerations



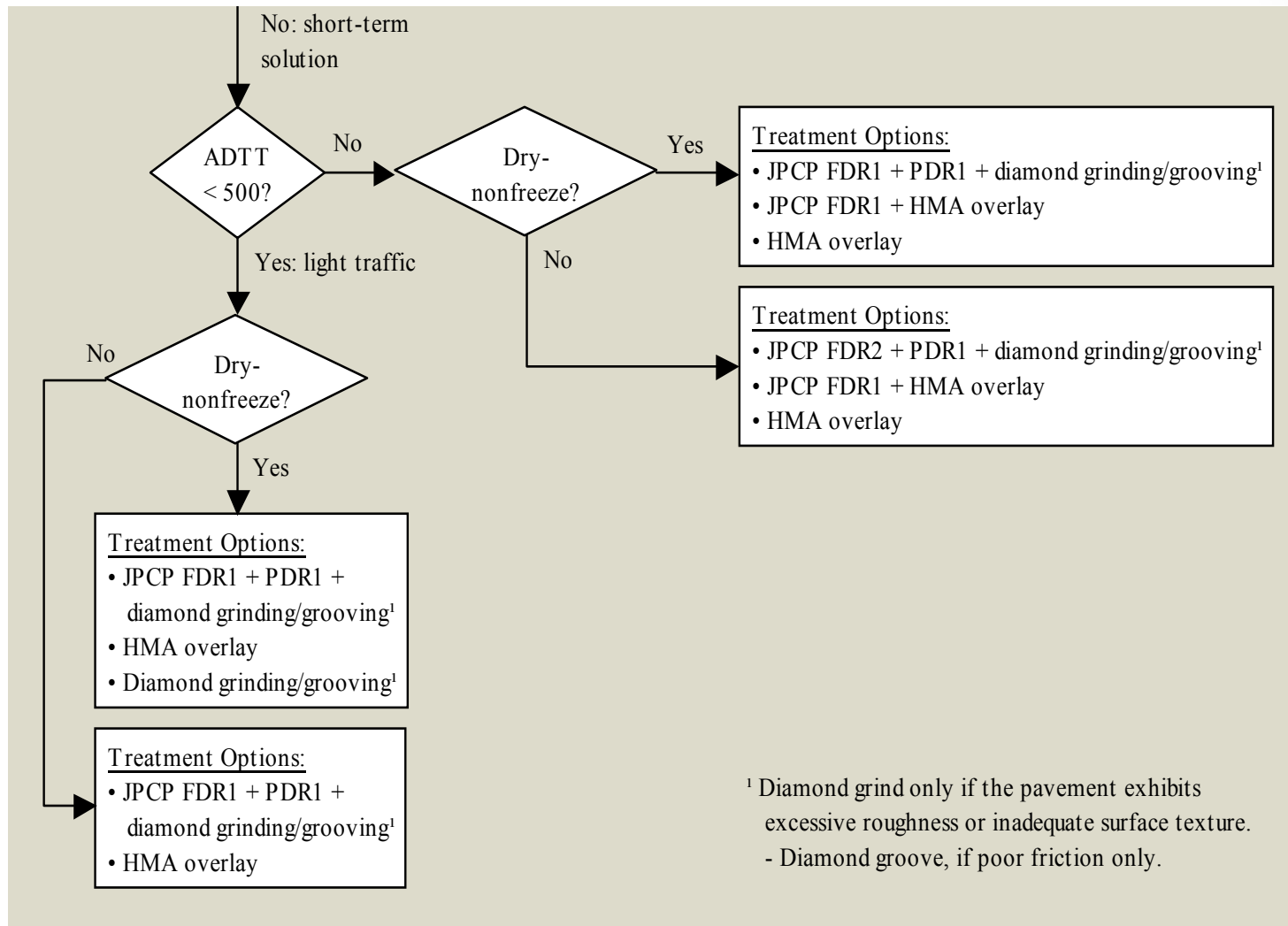
JPCP Structural Related Conditions

Short-Term Design: < 5-year Design Life

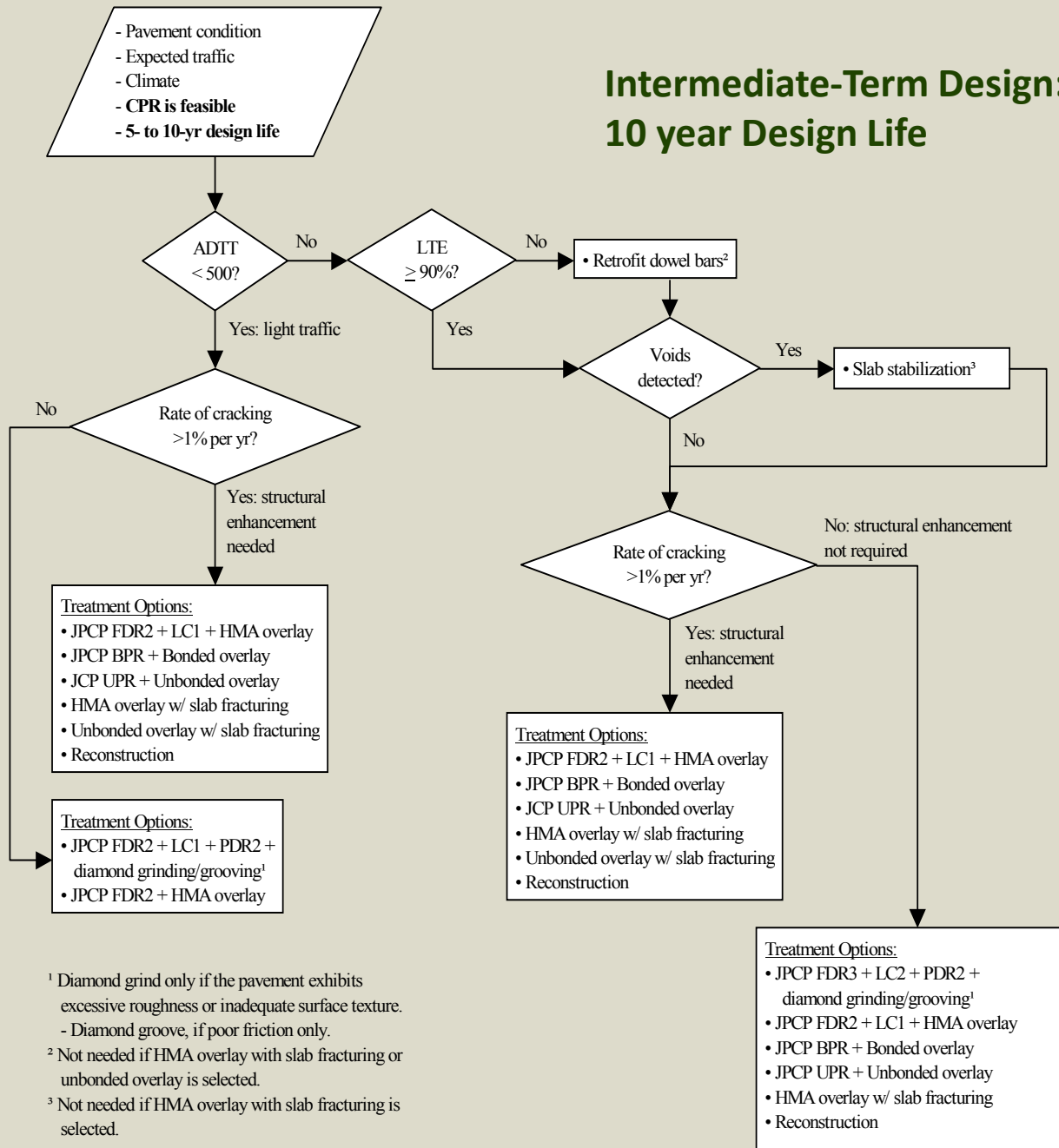


JPCP Structural Related Conditions

Short-Term Design: < 5-year Design Life



Intermediate-Term Design: 5-10 year Design Life



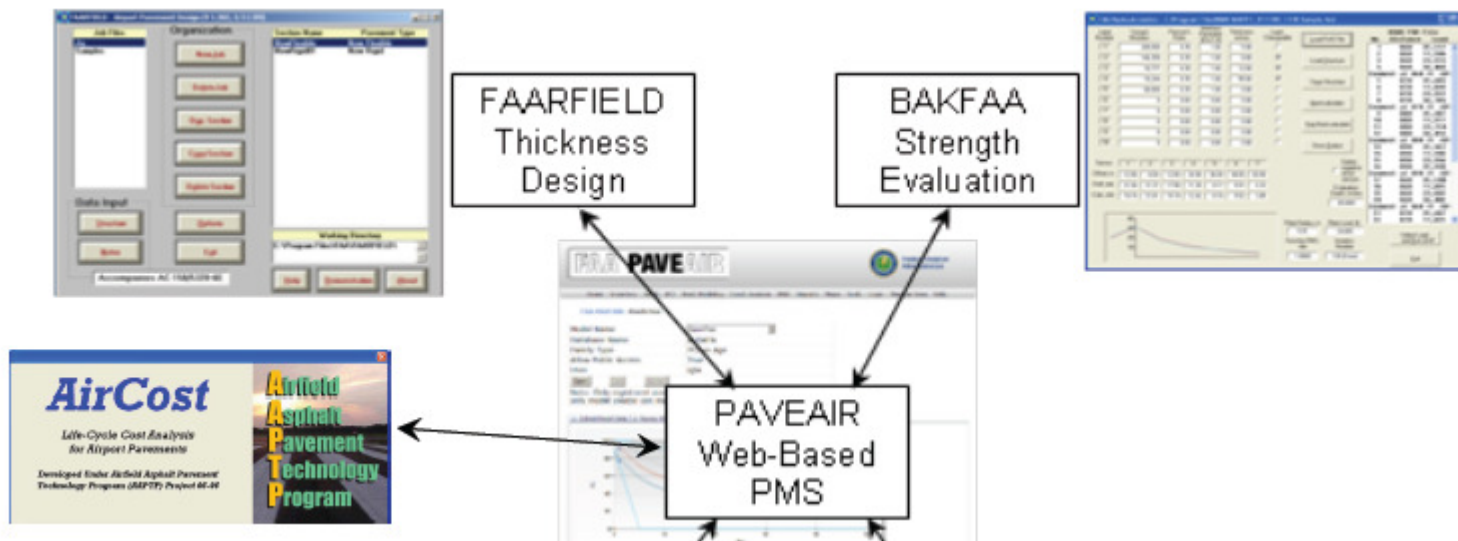
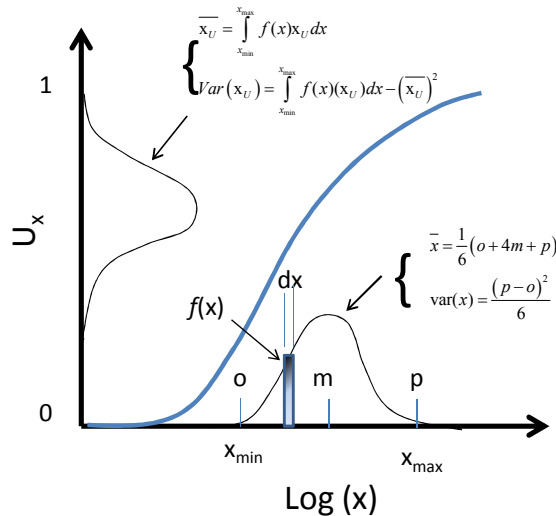
Step 7: Evaluate the most promising alternatives

Acceptable Alternatives:

- Existing structural and functional condition
- Remaining Life
- Life extension

Suitable Alternatives:

- Overall pavement condition improvement (combination of functional and structural)
- Time of construction
- Life extension
- First cost



Strategy Selection Criteria

Strategy Type	Decision Attribute	Weighted Attribute Component	Suggested Decision Criteria Limits (% of scaled value)
To Conduct Repair (CPR) <i>(Engineering driven solution)</i>	Structural Condition (SC)	Distress Type Distress Level Remaining Life (RL)	If SC Rating < 50% If RL Rating < 50%
	Functional Condition (FC)	Ride Profile Skid Resistance Tire Noise	If FC Rating < 50 %
	MRD Condition (DC)	ASR Steel Corrosion	Provided in table 4.4

Strategy Selection Criteria

Strategy Type	Decision Attribute	Weighted Attribute Component	Suggested Decision Criteria Limits (% of scaled value)
To Use Overlay	Suitability for Overlay	Life Extension (LE)	LE Rating > 50% (Jointed) LE Rating > 70% (CRC) LE Rating > 80% (HMAC)
To Reconstruct	Suitability for Reconstruction	Lane Capacity (LC) Remaining Life (RL) Life Extension (LE)	LC Rating < 50% RL Rating < 50% LE Rating < 25%

Distress Models

- Slab Cracking Model

$$\ln \%C = -\left(\frac{D}{\alpha}\right)^{\beta}$$

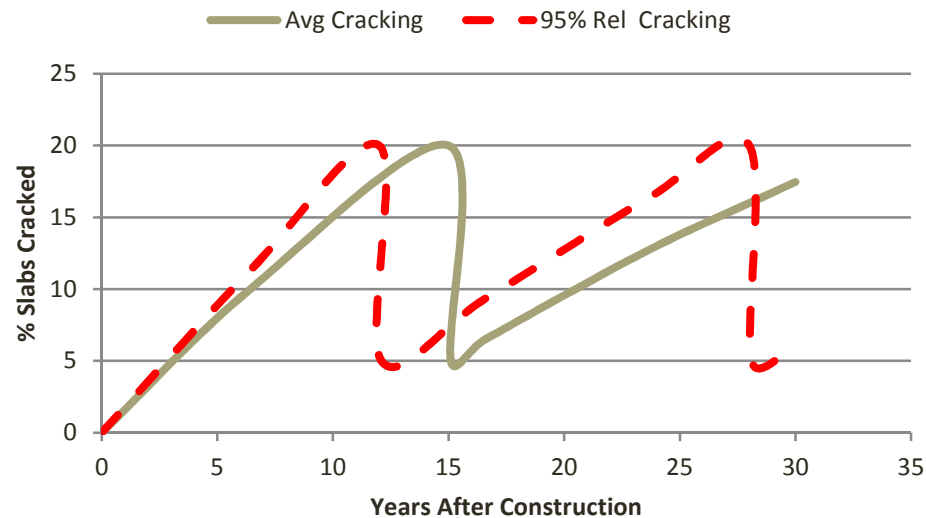
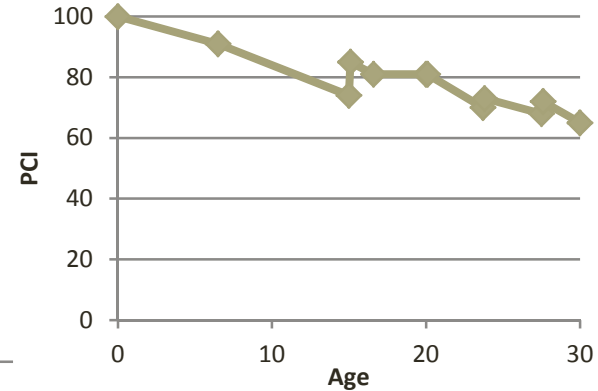
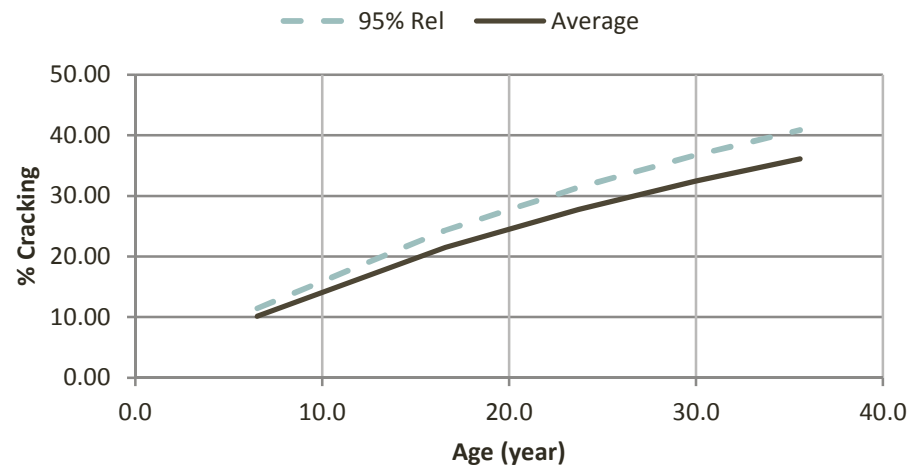
Where,

%C = percent of Cracking

D = relative accumulated damage

α, β = calibration coefficients based on local performance

Deterministic/Probabilistic



Preferred Alternatives

Activities:

- Select Feasible Treatments
- Identify Acceptable Treatment Combinations
 - Structural and Functional Pavement Condition
- Determine Traffic Impact and Time of Construction
- Estimate First Cost

Output:

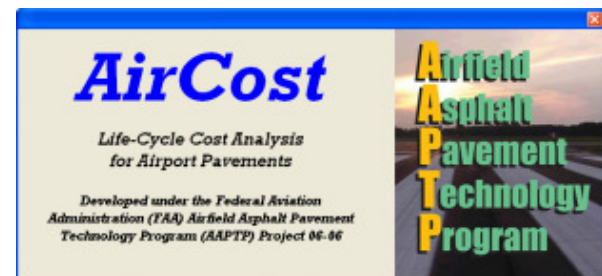
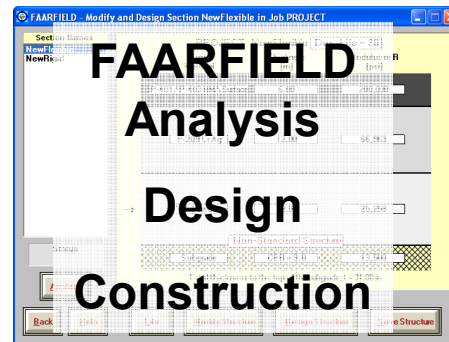
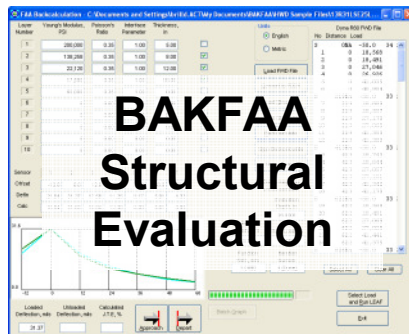
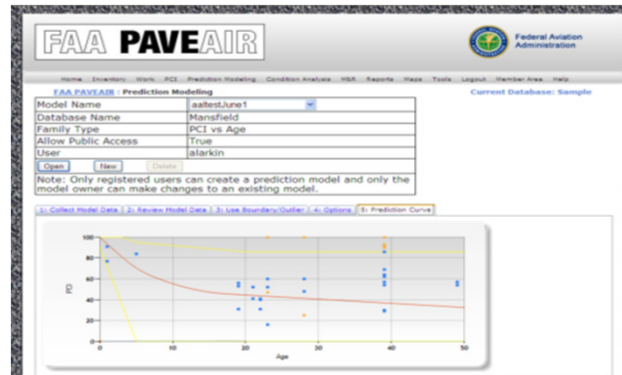
- Selection of Suitable Treatment Combinations
 - Overall Pavement Condition
 - Time of Construction
 - Life Extension
 - First Cost

The **Preferred Alternative** Combinations are developed from the **Suitable Treatment Combinations**

- LCCA/LCA

PAVEAIR Integration

Reconfigure the Tools



Summary

- Expand use and utility of FAARFIELD
- Improved and expanded use of performance modeling and calibration
 - Include climatic effects
 - Include variance
- Development of a decision making process (DMP) and criteria
 - Include variance
- Systematize the Alternative Development Process
- Set up LCCA (or AirCost) users group
 - Evaluate recommendations for improving AirCost
 - Develop plans for improving each sub-model (key elements) of AirCost
- Develop improved databases for pavement and user
 - For bid-price cost and cost-based estimating
 - For user unit costs (e.g., value of passenger time)